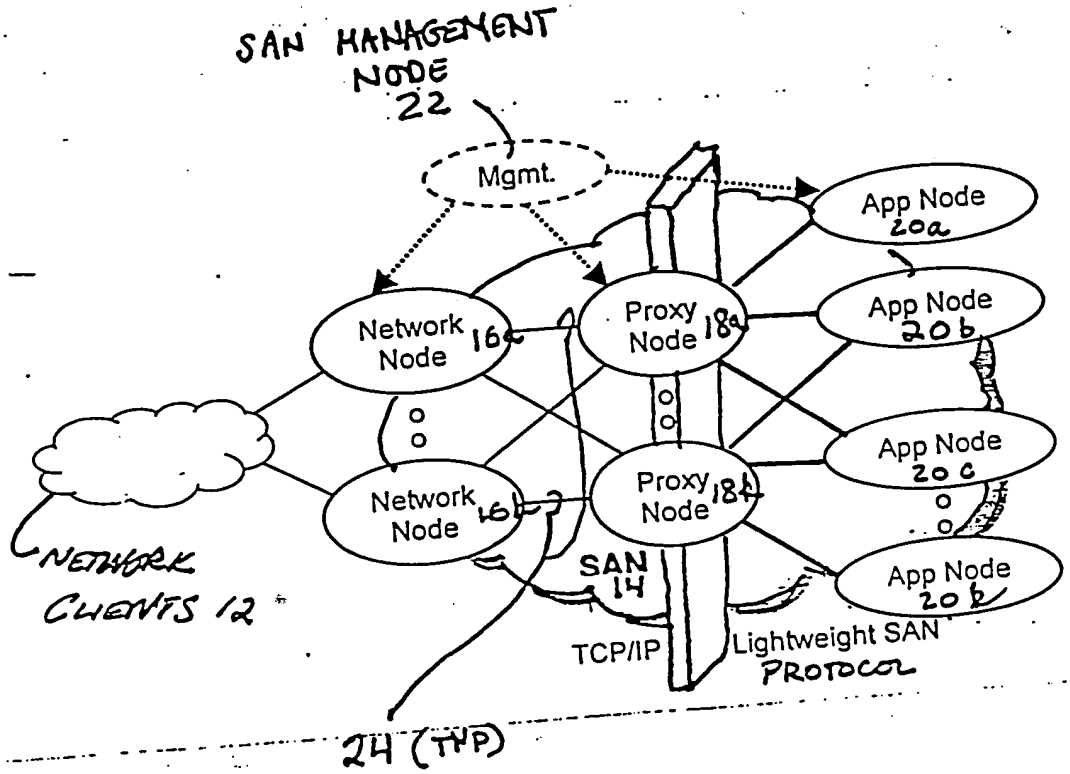

SAN MANAGEMENT NODE 22
10
Mgmt.
App Node 20a
Network Node 16a
Proxy Node 18a
App Node 20b
App Node 20c
Network Node 16b
Proxy Node 18b
SAN 14
App Node 20b
NETWORK CLIENTS 12
TCP/IP
Lightweight SAN PROTOCOL
24 (TYP)

FIG. 1

DOCKET NO. TVE-95-060

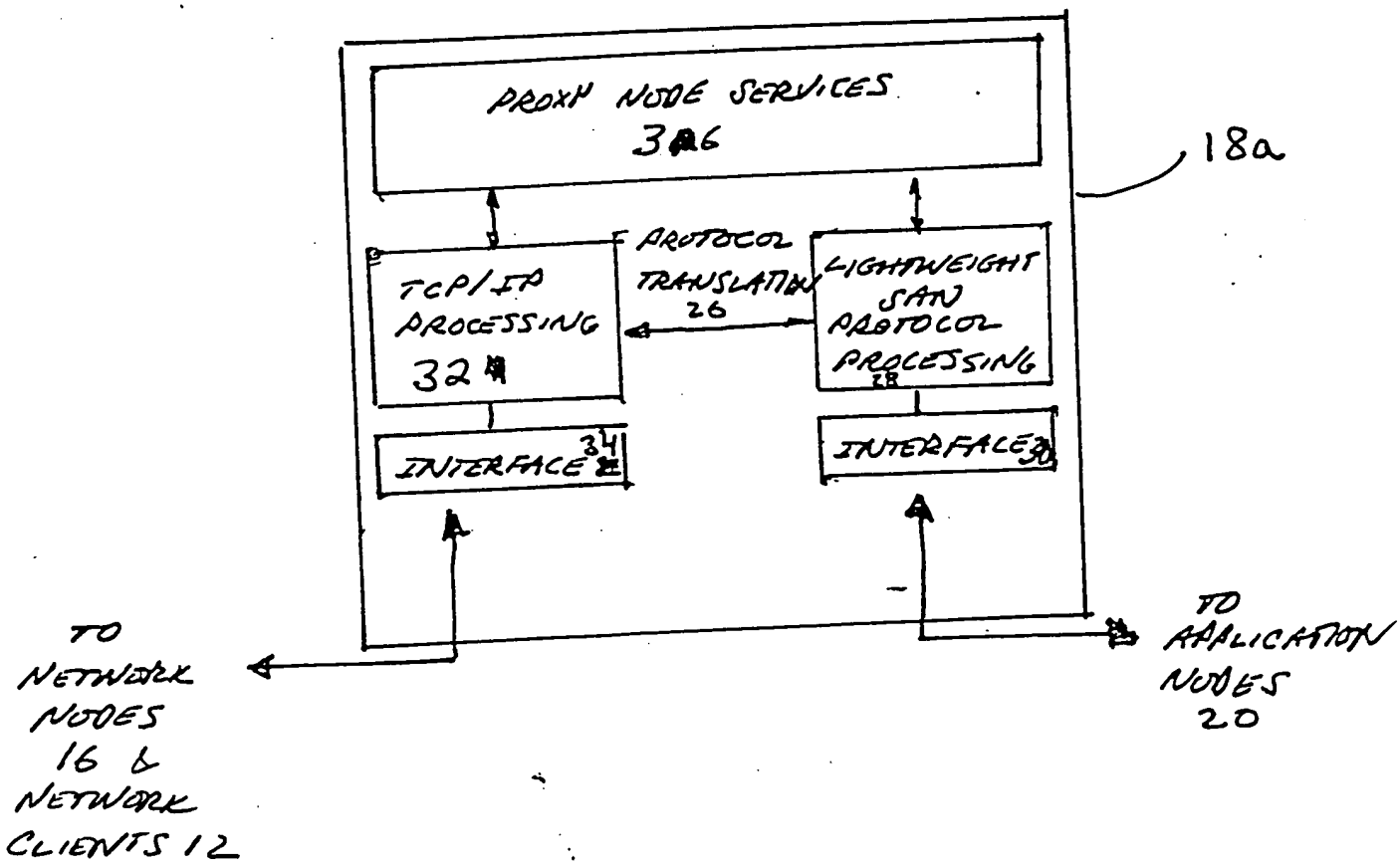


FIG. 2

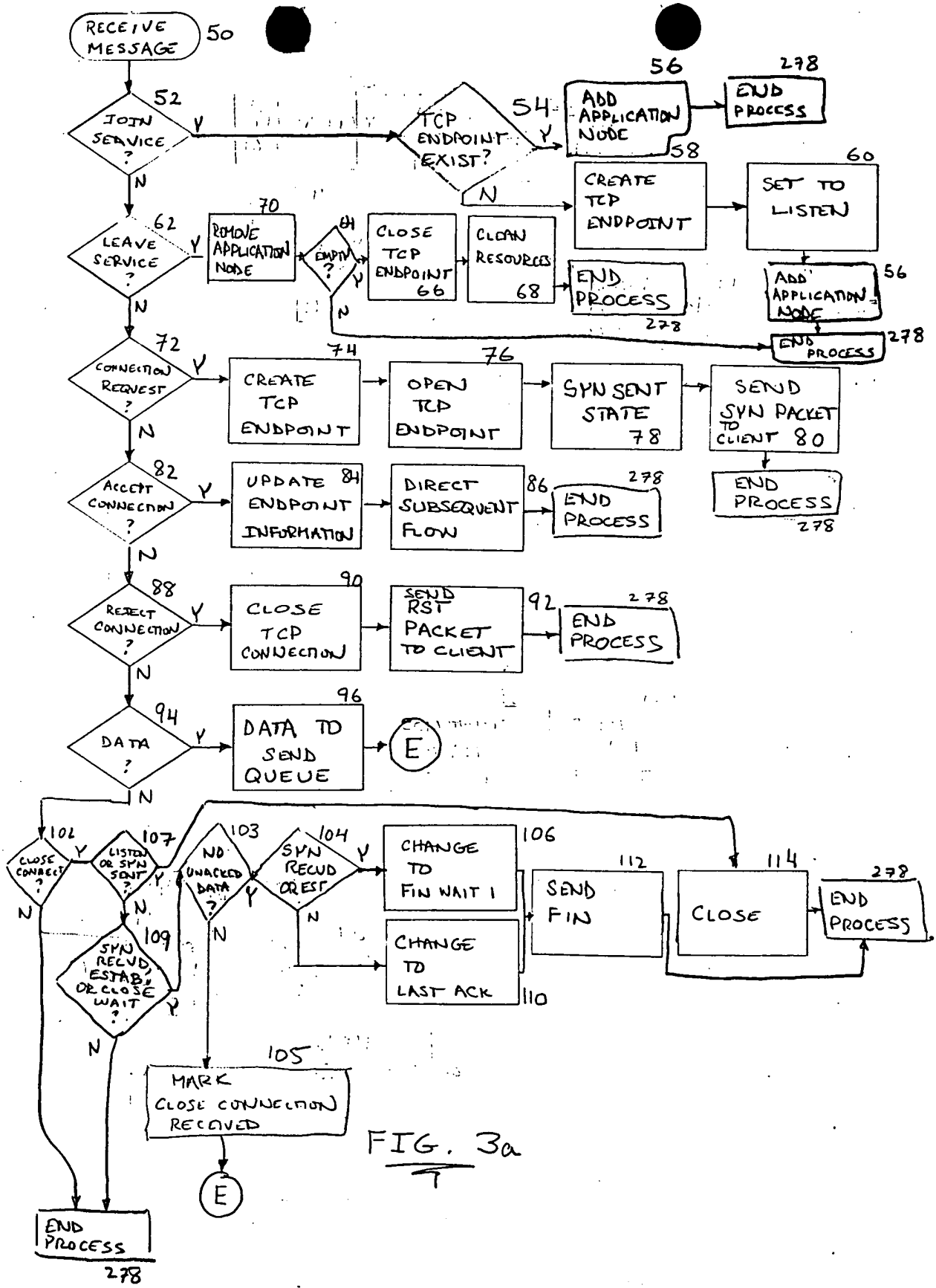

RECEIVE MESSAGE
50
JOIN SERVICE ?
52
TCP ENDPOINT EXIST?
54
ADD APPLICATION NODE
56
END PROCESS
278
CREATE TCP ENDPOINT
58
SET TO LISTEN
60
LEAVE SERVICE ?
62
REMOVE APPLICATION NODE
70
EMPTY ?
CLOSE TCP ENDPOINT 66
CLEAN RESOURCES 68
END PROCESS
278
ADD APPLICATION NODE
56
END PROCESS
278
CONNECTION REQUEST ?
72
CREATE TCP ENDPOINT
74
OPEN TCP ENDPOINT
76
SYN SENT STATE 78
SEND SYN PACKET TO CLIENT 80
END PROCESS
278
ACCEPT CONNECTION ?
82
UPDATE ENDPOINT INFORMATION
84
DIRECT SUBSEQUENT FLOW
86
END PROCESS
278
REJECT CONNECTION ?
88
CLOSE TCP CONNECTION
90
SEND RST PACKET TO CLIENT
92
END PROCESS
278
DATA ?
94
DATA TO SEND QUEUE
96
E
CLOSE CONNECT ?
101
LISTEN OR SYN SENT ?
107
NO UNACKED DATA ?
103
SYN RECVD ORIG ?
104
CHANGE TO FIN WAIT 1
106
SEND FIN
112
CLOSE
114
END PROCESS
278
CHANGE TO LAST ACK
110
SYN RECVD, ESTAB, OR CLOSE WAIT ?
109
MARK CLOSE CONNECTION RECEIVED
105
E
END PROCESS
278
Y
N

FIG. 3a

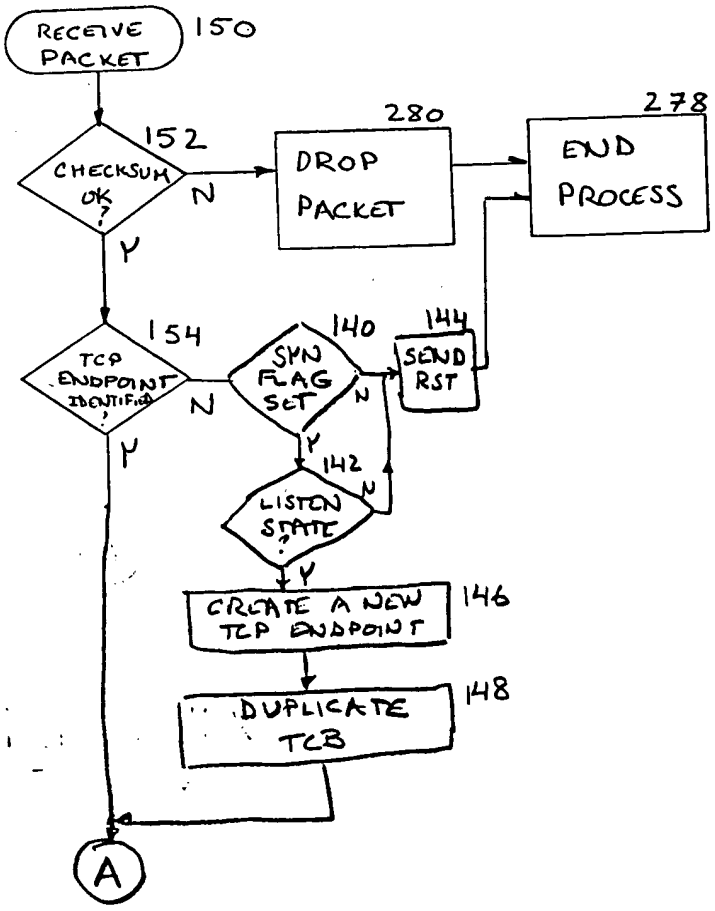

RECEIVE PACKET
150
152
CHECKSUM OK ?
N
Y
280
DROP PACKET
278
END PROCESS
154
TCP ENDPOINT IDENTIFIED ?
N
Y
140
SYN FLAG SET
N
Y
144
SEND RST
142
LISTEN STATE ?
N
Y
146
CREATE A NEW TCP ENDPOINT
148
DUPLICATE TCB
A

FIG 3B.

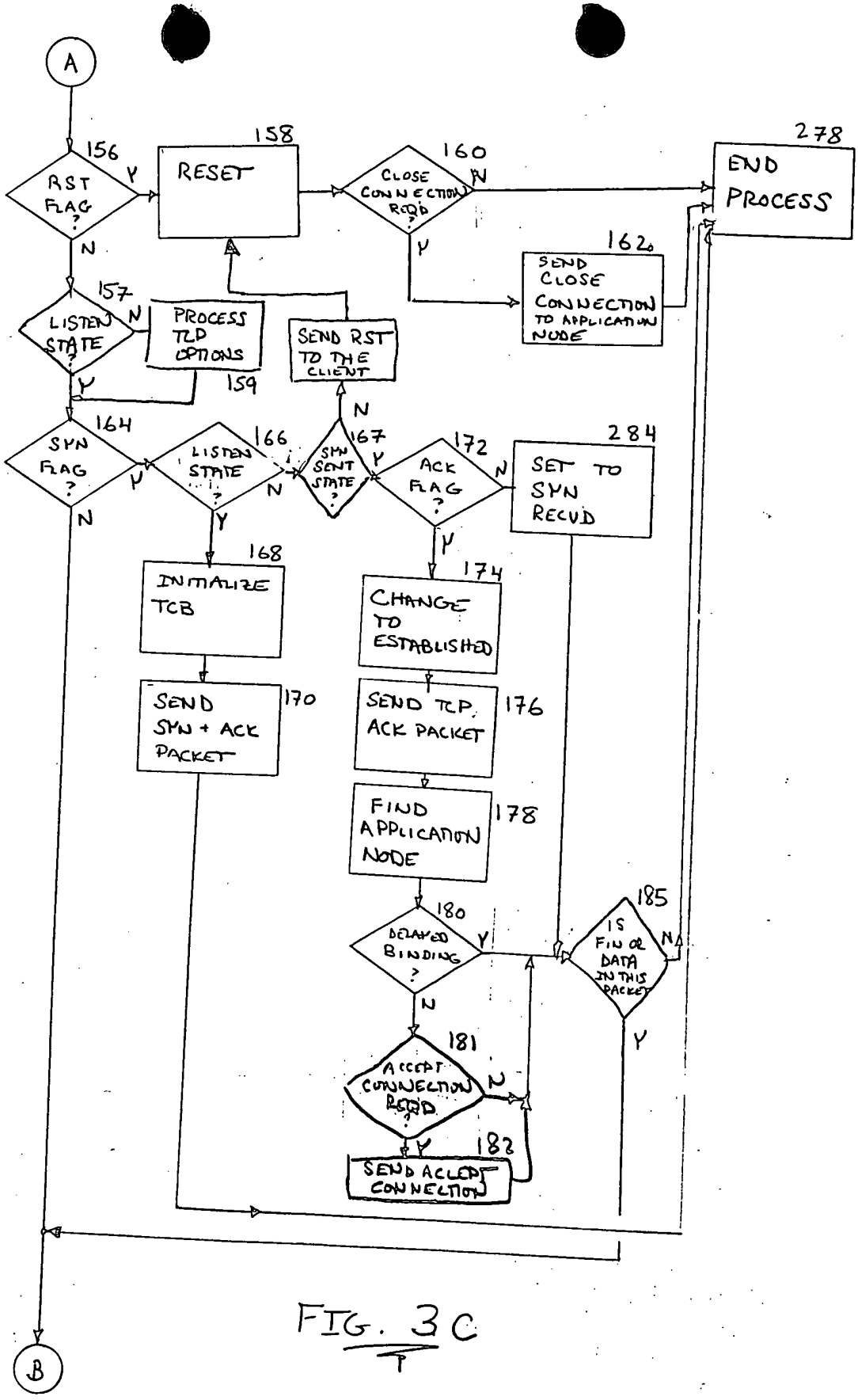

A
156
RST FLAG ?
Y
N
158
RESET
160
CLOSE CONNECTION RCVD ?
N
Y
278
END PROCESS
162
SEND CLOSE CONNECTION TO APPLICATION NODE
157
LISTEN STATE ?
N
Y
PROCESS TCP OPTIONS
159
SEND RST TO THE CLIENT
164
SYN FLAG ?
Y
N
166
LISTEN STATE ?
N
Y
167
SYN SENT STATE ?
Y
N
172
ACK FLAG ?
N
Y
284
SET TO SYN RCVD
168
INITIALIZE TCB
170
SEND SYN + ACK PACKET
174
CHANGE TO ESTABLISHED
176
SEND TCP ACK PACKET
178
FIND APPLICATION NODE
180
DELAYED BINDING ?
Y
N
181
ACCEPT CONNECTION RCVD ?
N
Y
182
SEND ACCEPT CONNECTION
185
IS FIN OR DATA IN THIS PACKET
N
Y
B

FIG. 3C

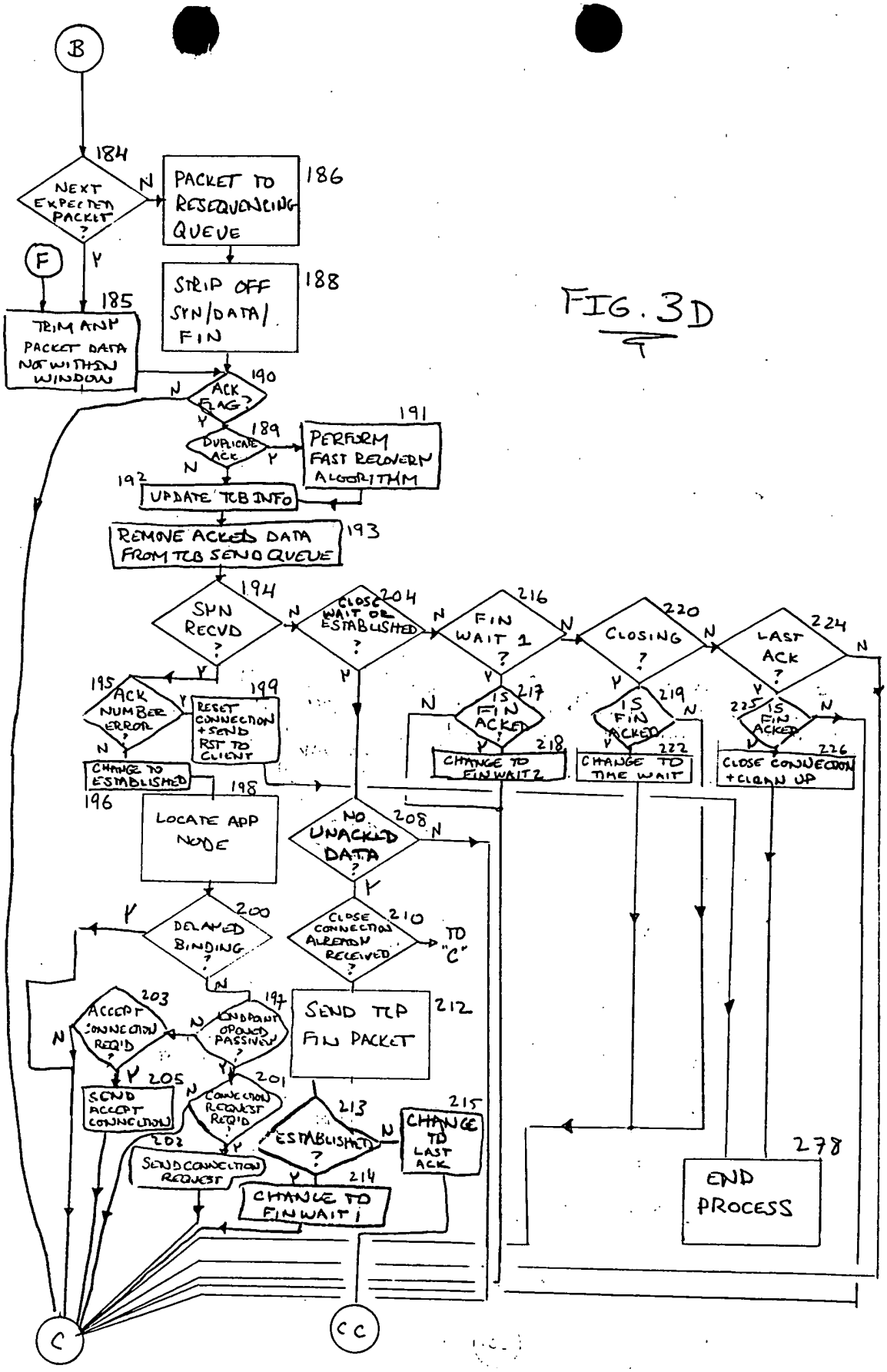
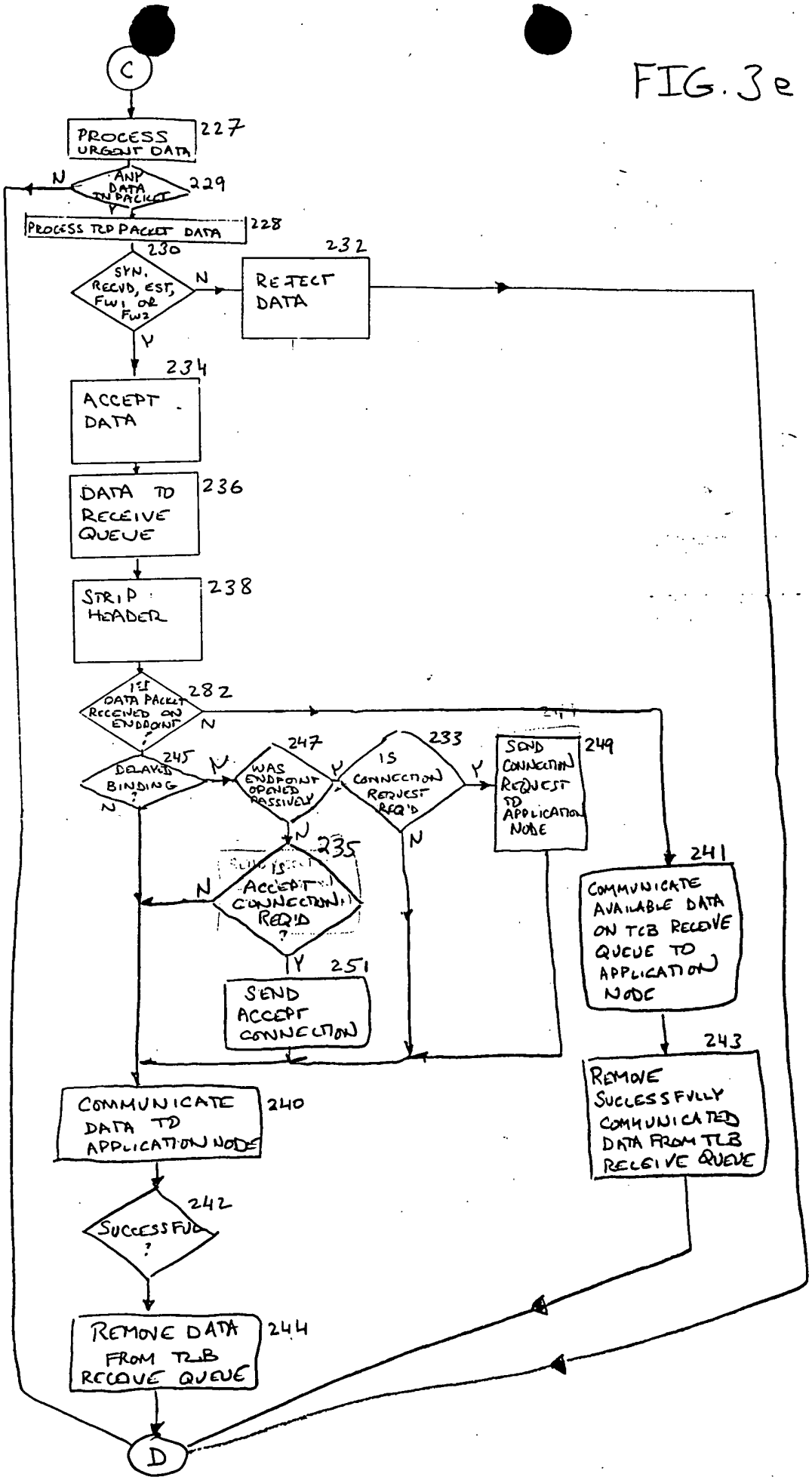

B
184
NEXT EXPECTED PACKET ?
N
PACKET TO RESEQUENCING QUEUE
186
F
Y
STRIP OFF SYN/DATA/ FIN
188
185
TRIM ANY PACKET DATA NOT WITHIN WINDOW
190
ACK FLAG ?
N
Y
189
DUPLICATE ACK
Y
N
191
PERFORM FAST RECOVERY ALGORITHM
192
UPDATE TCB INFO
193
REMOVE ACKED DATA FROM TCB SEND QUEUE
194
SYN RECVD ?
204
CLOSE WAIT OR ESTABLISHED ?
216
FIN WAIT 1 ?
220
CLOSING ?
224
LAST ACK ?
195
ACK NUMBER ERROR ?
199
RESET CONNECTION + SEND RST TO CLIENT
CHANGE TO ESTABLISHED
196
198
LOCATE APP NODE
217
IS FIN ACKED ?
218
CHANGE TO FINWAIT2
219
IS FIN ACKED ?
222
CHANGE TO TIME WAIT
225
IS FIN ACKED ?
226
CLOSE CONNECTION + CLEAN UP
208
NO UNACKED DATA ?
200
DELAYED BINDING ?
210
CLOSE CONNECTION ALREADY RECEIVED ?
TO "C"
203
ACCEPT CONNECTION REQ'D ?
197
ENDPOINT OPENED PASSIVELY ?
212
SEND TCP FIN PACKET
205
SEND ACCEPT CONNECTION
201
CONNECTION REQUEST REQ'D ?
213
ESTABLISHED ?
215
CHANGE TO LAST ACK
202
SEND CONNECTION REQUEST
214
CHANGE TO FINWAIT1
278
END PROCESS
C
CC

FIG. 3D

FIG. 3e


C
PROCESS URGENT DATA
227
ANY DATA IN PACKET
229
N
Y
PROCESS TCP PACKET DATA
228
230
SYN, RCVD, EST, FW1 OR FW2
N
232
REJECT DATA
Y
234
ACCEPT DATA
DATA TO RECEIVE QUEUE
236
STRIP HEADER
238
1ST DATA PACKET RECEIVED ON ENDPOINT
282
N
DELAYED BINDING
245
Y
N
247
WAS ENDPOINT OPENED PASSIVELY
Y
N
233
IS CONNECTION REQUEST REQ'D
Y
N
249
SEND CONNECTION REQUEST TO APPLICATION NODE
235
ACCEPT CONNECTION REQ'D
N
Y
251
SEND ACCEPT CONNECTION
241
COMMUNICATE AVAILABLE DATA ON TCB RECEIVE QUEUE TO APPLICATION NODE
243
REMOVE SUCCESSFULLY COMMUNICATED DATA FROM TCB RECEIVE QUEUE
COMMUNICATE DATA TO APPLICATION NODE
240
242
SUCCESSFUL
?
REMOVE DATA FROM TCB RECEIVE QUEUE
244
D

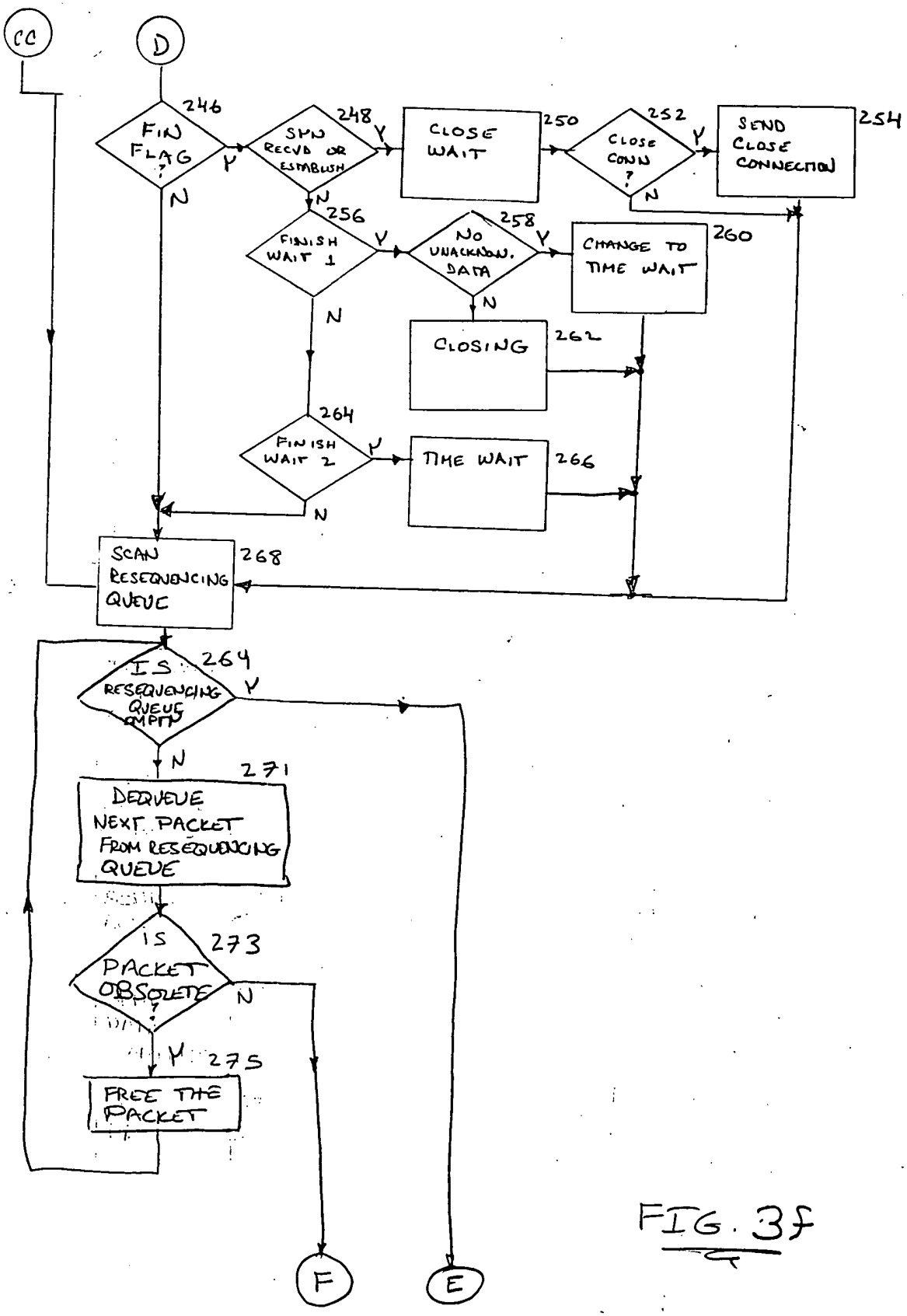

CC
D
246
FIN FLAG ?
Y
N
248
SYN RECVD OR ESTABLISH
Y
N
CLOSE WAIT
250
252
CLOSE CONN ?
Y
N
SEND CLOSE CONNECTION
254
256
FINISH WAIT 1
Y
N
258
NO UNACKNOWL. DATA
Y
N
CHANGE TO TIME WAIT
260
CLOSING
262
264
FINISH WAIT 2
Y
N
TIME WAIT
266
SCAN RESEQUENCING QUEUE
268
IS RESEQUENCING QUEUE EMPTY
264
Y
N
271
DEQUEUE NEXT PACKET FROM RESEQUENCING QUEUE
IS PACKET OBSOLETE ?
273
N
Y
275
FREE THE PACKET
F
E

FIG. 3f

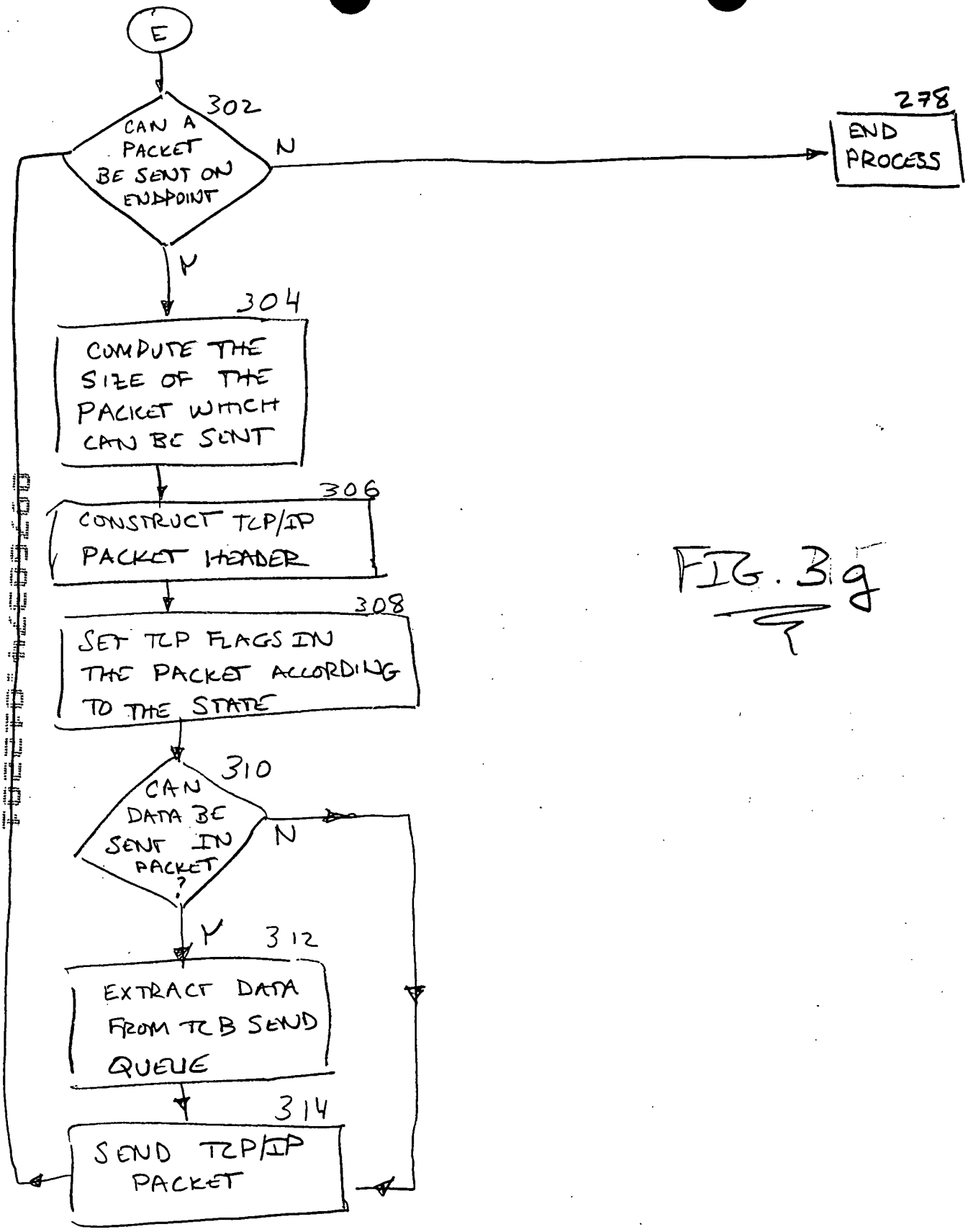

E
302
CAN A PACKET BE SENT ON ENDPOINT
N
278
END PROCESS
Y
304
COMPUTE THE SIZE OF THE PACKET WHICH CAN BE SENT
306
CONSTRUCT TCP/IP PACKET HEADER
308
SET TCP FLAGS IN THE PACKET ACCORDING TO THE STATE
310
CAN DATA BE SENT IN PACKET ?
N
Y
312
EXTRACT DATA FROM TCB SEND QUEUE
314
SEND TCP/IP PACKET

FIG. 3g

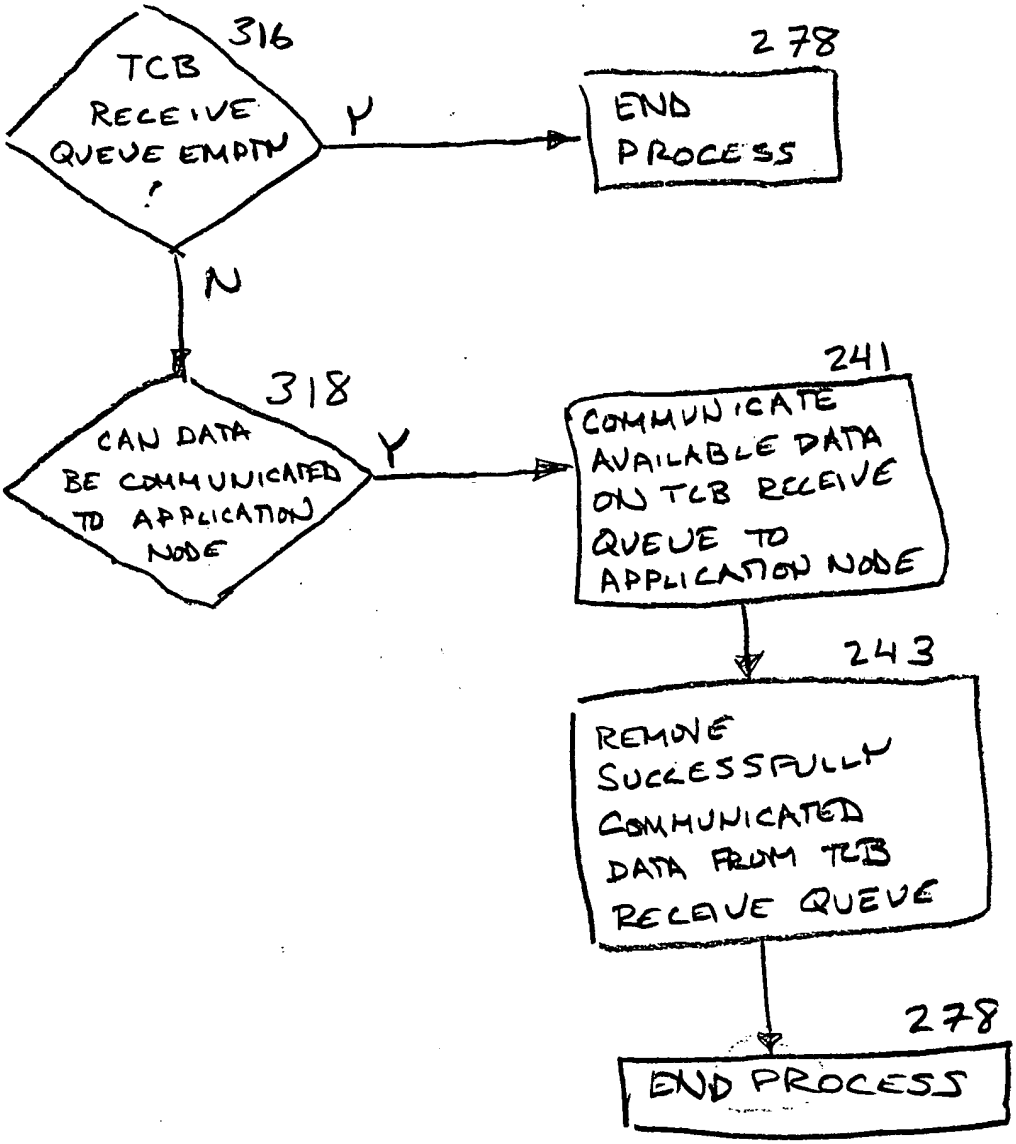

316
TCB RECEIVE QUEUE EMPTY ?
Y
278
END PROCESS
N
318
CAN DATA BE COMMUNICATED TO APPLICATION NODE
Y
241
COMMUNICATE AVAILABLE DATA ON TCB RECEIVE QUEUE TO APPLICATION NODE
243
REMOVE SUCCESSFULLY COMMUNICATED DATA FROM TCB RECEIVE QUEUE
278
END PROCESS

FIG 4G

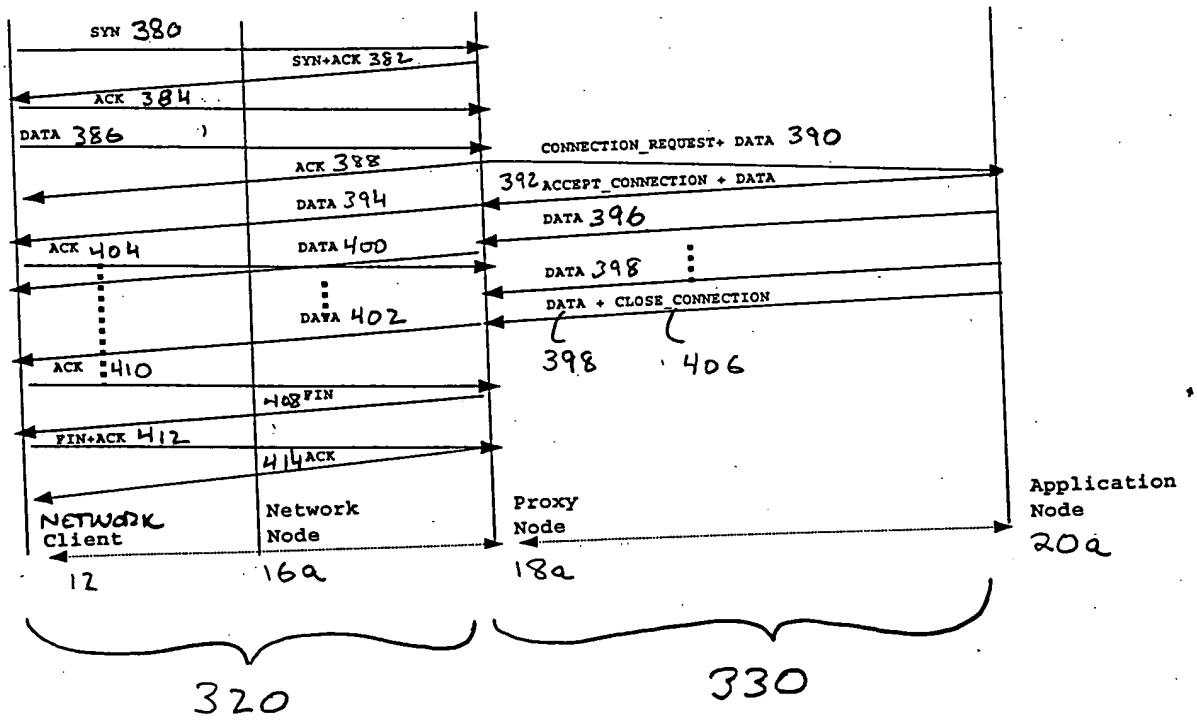

SYN 380
SYN+ACK 382
ACK 384
DATA 386
CONNECTION_REQUEST+ DATA 390
ACK 388
392 ACCEPT_CONNECTION + DATA
DATA 394
DATA 396
ACK 404
DATA 400
DATA 398
DATA 402
DATA + CLOSE_CONNECTION
398
406
ACK 410
408 FIN
FIN+ACK 412
414 ACK
NETWORK Client
Network Node
Proxy Node
Application Node 20a
12
16a
18a
320
330

FIG. 5

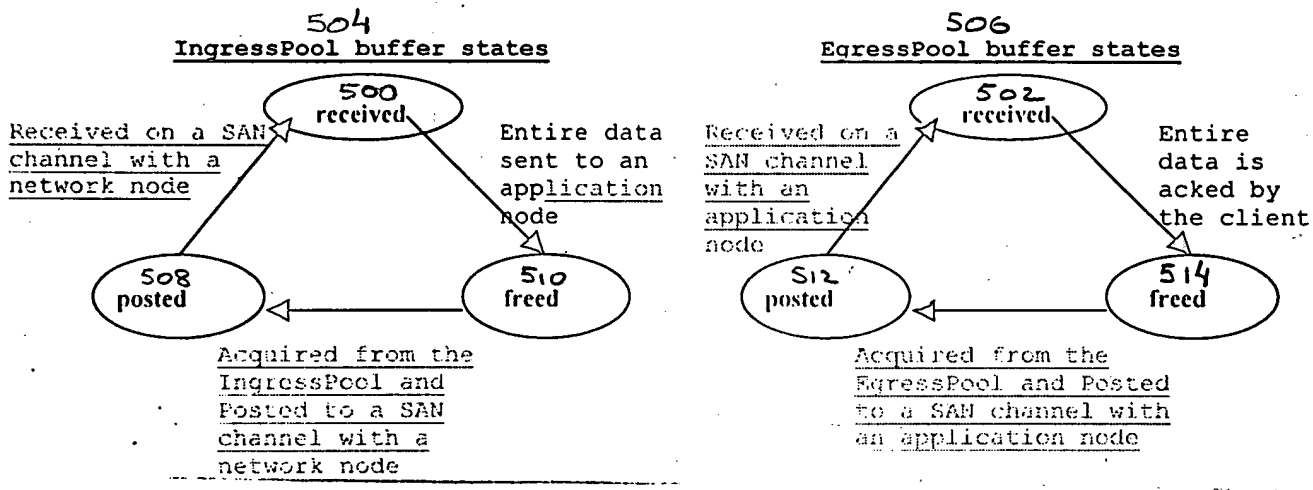

504
IngressPool buffer states
500
received
Received on a SAN channel with a network node
Entire data sent to an application node
508
posted
510
freed
Acquired from the IngressPool and Posted to a SAN channel with a network node
506
EgressPool buffer states
502
received
Received on a SAN channel with an application node
Entire data is acked by the client
512
posted
514
freed
Acquired from the EgressPool and Posted to a SAN channel with an application node

FIG. 6